Port Idling Emission Reduction Technologies For Large Cargo Vessels

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Presentation Contents

- Growing maritime emission pressures
- MARAD Energy Technologies Program
- Comparison of cargo vessel & truck “Idling”
- Vessel port call and emission statistics
- Cargo vessel “Anti-Idling” projects
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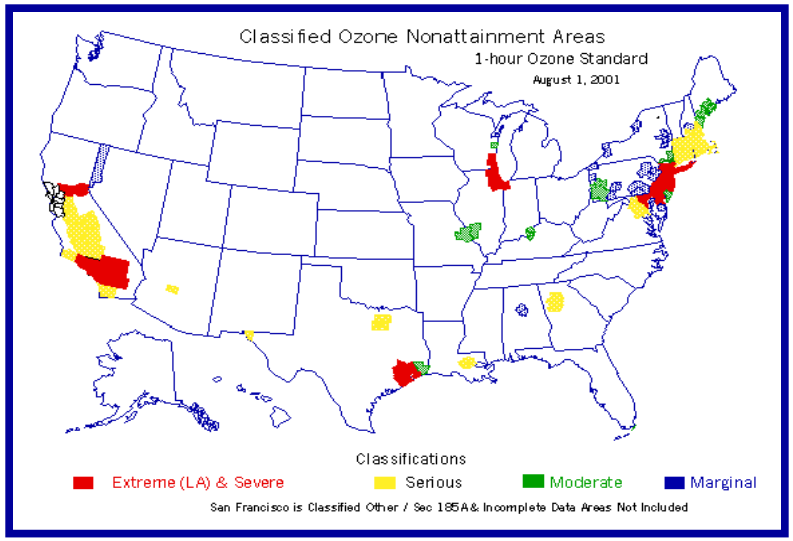
GROWING MARITIME EMISSION PRESSURES

Increasing Emission Pressures

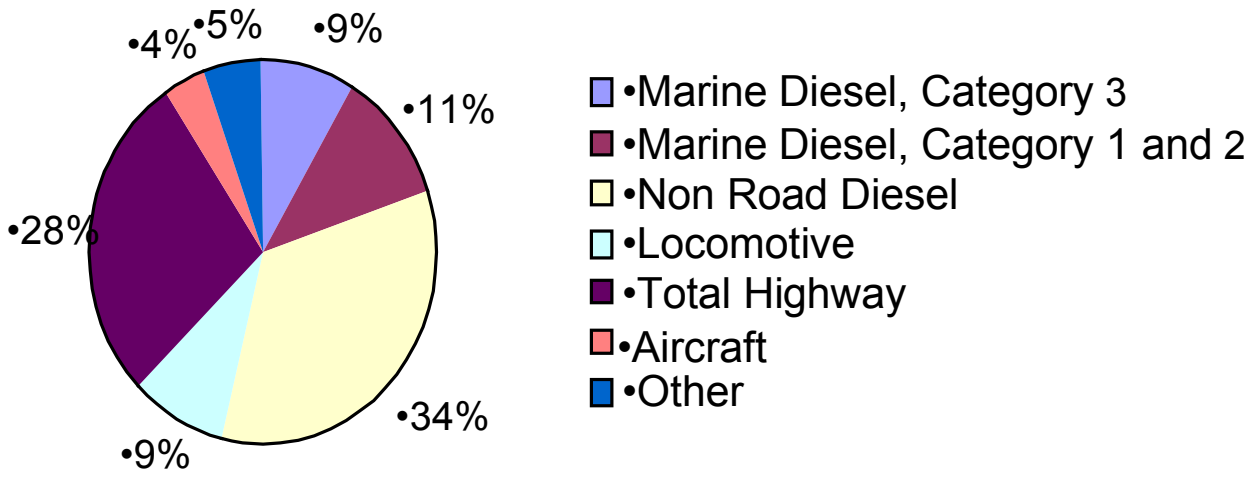


U.S. Ozone Nonattainment Areas

- **Maritime in spotlight**
- **MARPOL Annex 6**
  - NOx and Sulfur limits in 2004
- **EPA regulations**
  - New category 1, 2 eng's (1999)
    - NOx, HC, CO, and PM
  - New category 3 eng's (2002)
- **CARB regulation**
  - Ferries use hwy diesel
- **Ozone Nonattainment**
- **Public pressure**

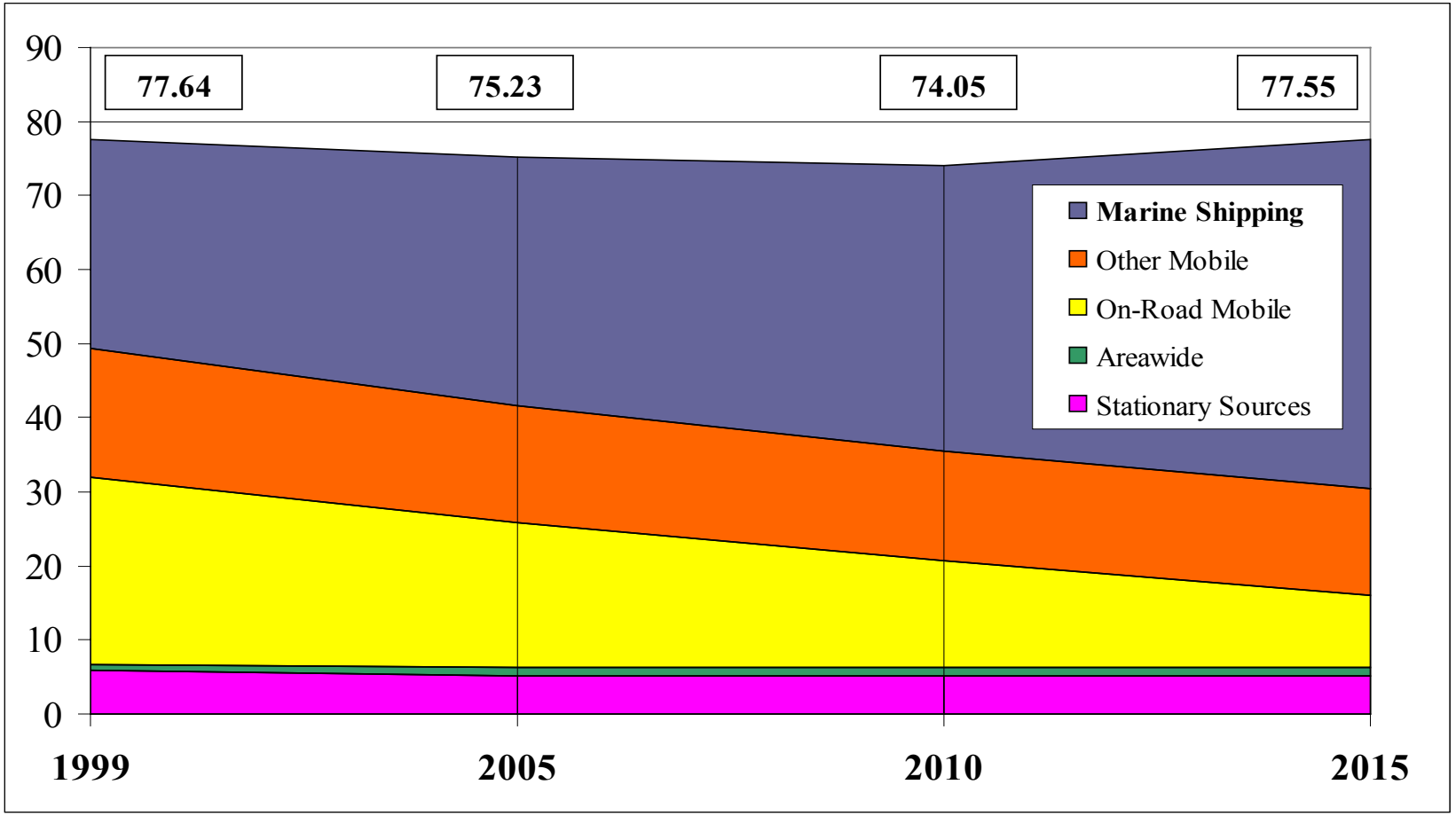
Forecasted Percentage - Mobile Source NOx Emissions

•EPA Modeled Annual• NOx Emissions Source
•Percentages for Mobile-Source Categories in 2030



- **Marine diesels to account for 20% of mobile NOx emissions in 2030**
  - **Up from 7% in 2000**

Growing Marine Emissions
Santa Barbara NOx Example



NOx Tons per Day

Slide Courtesy of SBCAPCD

MARAD Energy Technologies Program

Program Objectives

- **Investigate and demonstrate the potential for new technologies and fuels to improve marine power plant efficiency and to reduce air emissions**

- **Disseminate energy technology and related policy information to the maritime community**

Program Plan

- **Baseline performance testing**
  - Existing vessel data and measurement techniques
- **Diesel retrofits**
  - Emulsified fuel, water injection, SCR, particulate traps
- **Alternative fuels**
  - Natural gas, biodiesel, hydrogen, synthetic diesel
- **Advanced technologies**
  - Fuel cells, high efficiency gas turbines
- **Supporting studies**
  - Technology evaluations, incentives & emission measuring
- **Industry outreach**
  - Newsletter, conferences, web site, and presentations

Partners

RSPA research and special programs administration

University of Delaware

SCX Ferries

Bay Area Air Quality Management District

BLUE & GOLD FLEET

NAVSEA PHILADELPHIA Ships Systems Engineering Station

U.S. Department of Transportation Federal Highway Administration

SUREPOWER™ CORPORATION

Federal Transit Administration

JJMA An Employee Owned Company

U.S. COAST GUARD

California Air Resources Board

West Virginia University

Matson

Santa Barbara County Air Pollution Control District

SAN FRANCISCO WATER TRANSIT AUTHORITY

ABS

bp marine

THE PORT OF LONG BEACH

BROOKHAVEN NATIONAL LABORATORY

CASRM Center for Advanced Ship Repair and Maintenance

PRIME, Inc.

MIDAS

Seaworthy

gti

Red and White Fleet SINCE 1892 – THE SAN FRANCISCO SIGHTSEEING TRADITION

Port of Houston Authority

EPA United States Environmental Protection Agency

HRT Hampton Roads Transit

Projects
Retrofits and Fuel Demos

MV WAVERIDER - San Diego

MV OSKI - San Francisco Bay

MV ECHOLS - Norfolk

NAVSEA - Philadelphia

Staten Island Ferries

N.Y. Harbor Private Ferries

California Cargo Vessels

- **Technologies**
  - Fumigation (water injection system)
  - Fuel emulsification
  - Selective catalytic reduction
  - Combustion chamber mods
  - Injector modifications
  - Ferrocene additive
  - Particulate trap
- **Fuels**
  - Biodiesel
  - 15 PPM Sulfur Diesel
  - Fischer Tropsch Diesel

Comparison of Cargo Vessel and Truck “Idling”

Comparison of Cargo Vessel and Truck "Idling"

- **Truck Idling**
  - Truck stopped
  - Main engine on for hotel load
  - Main engine "idling"
  - Aux. generators one solution
  - "Shorepower" possible

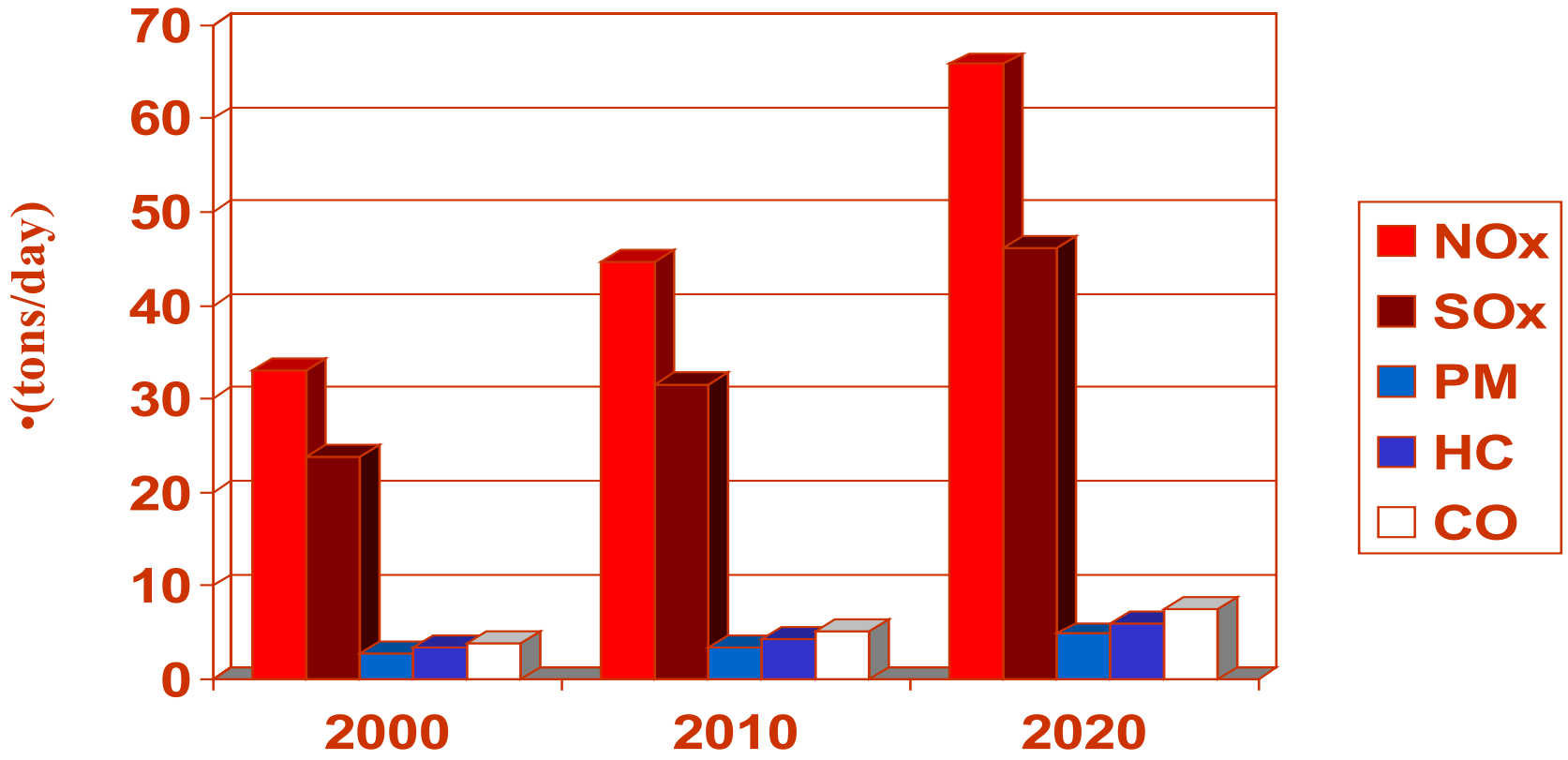
- **Cargo Vessel "Idling"**
  - In port cargo operations
  - Main engine off
  - Aux. generators on "hotel" load
  - Could include cargo load
  - Aux engines - loaded condition
  - Control technologies needed
  - "Shorepower" possible

Port Call
and Emission Statistics

Port Statistics

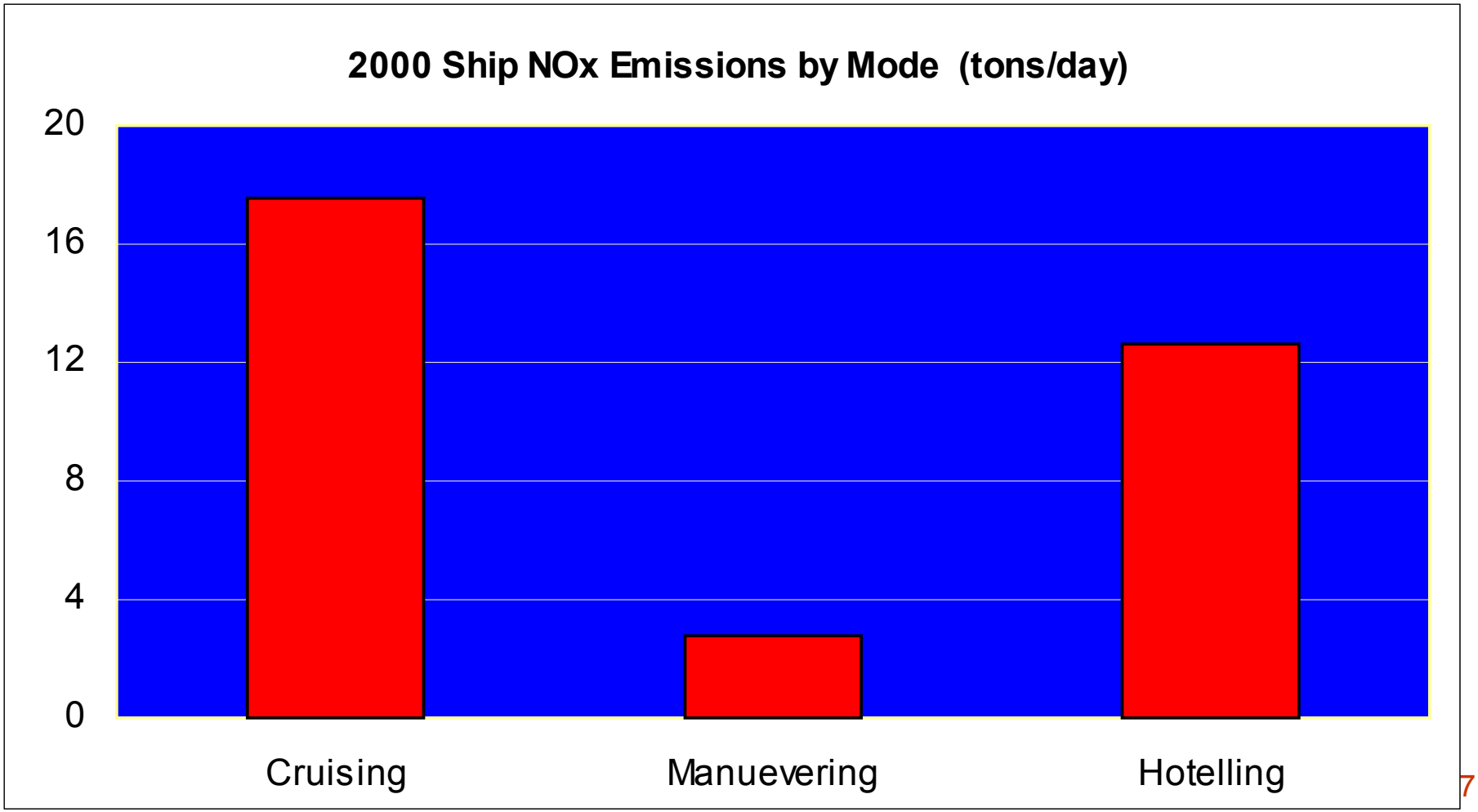
- National
  - 52,000 foreign trade U.S. port calls per year
  - 93% foreign vessel, most w/large 2-stroke engines
  - Utilize blended residual fuel usually 2 - 3 % sulfur
  - Aux. generator engines 4 stroke medium speed
  - Existing engines unregulated w/ slow turnover
- Port of LA
  - 5600 ship visits per year, container ship > 50%
  - Typ. container ship hotel load = 3,000 kW @ 48 hrs
  - Cargo throughput projected to triple by 2020
  - Port expansion - No NOx, PM, net increase allowed

Port of Los Angeles
Vessel Emission Trends



•Business as usual trend

Port of LA
Vessel Emission Breakdown



Cargo Vessel “Anti-Idling” Projects

Baseline Emission Testing

- MV SINE MAERSK - Container vessel
  - L.A. to Tacoma
- Sponsor - Port of LA w/MARAD assist
- Parties Involved - Maersk Lines, MAN B&W, University of California Riverside, CARB
- NOx, PM, HC, CO and CO_2 Tested
- Testing both underway and at pier
- Port “idling” on auxiliary gensets
  - 12.5 NOx g/kW-h , no PM data available

Cargo Vessel
Diesel Engine Retrofit Projects

- **Sponsors**
  - **MARAD, DOT CCCEF, EPA, Ports LA & LB, CARB, Air Quality Districts**
- **Cooperative research**
  - **w/ Vessel operators**
- **Cruising California coast**
- **Hotel (Idling) loads in port**
- **Main engine**
- **Auxiliary engines**

"Anti-Idling" Technology

Fuel emulsification

Target 25% NOx reduction

Reduced sulfur fuel

SOx and PM reduction

"Idling" NOx Emission Reductions - Emulsion System

- **Container vessel**
  - 10 trips/year to two California ports
  - Develops 3000 kW hotel load for 48 hours
- **US Port NOx reduction**
  - Target 25%
  - NOx production - 10 trips x 2 calls/trip x 48 hrs/call x 3000 kW x 12.5 g NOx/kW-hr x lb/454 g x Ton/2000 lbs = 40 Tons NOx/yr.
  - 40 Tons x 25% = 10 Ton NOx reduced/year

"Idling" PM Emission Reductions - Low Sulfur Diesel

- **Container vessel**
  - Same profile as preceding slide
- **Fuel Characteristics**
  - IFO 380 cSt (blended) - 25,OOO ppm sulfur typical
  - MGO (diesel no. 2) - 500 ppm sulfur likely
- **US Port PM reduction**
  - Target > 40%
  - PM production - 10 trips x 2 calls/trip x 48 hrs/call x 3000 kW x 3.0 g PM/kW-hr x lb/454 g x Ton/2000 lbs = 9.5 Tons PM/yr.
  - 9.5 Tons x 40% = 3.8 Tons PM reduced/year

Shorepower as an Option

- **Applications**
  - Juneau, Alaska cruise ships
  - Port of LA considering
- **Challenges**
  - Ship conversions needed - high shore power load
  - Varied voltages, frequencies, and transformers
  - Large 3 phase power cable handling
  - Crane and cargo equipment interference
  - Very expensive per application
  - Port evacuation security considerations

Contact Information

Web Site and Contact Info

- Daniel.Gore@MARAD.DOT.GOV
  - (202) 366-1886
- www.marad.dot.gov/nmrec/
  - Link to “Energy Technologies”
- No-cost newsletter subscription